



BEEST

ELECTRIC VEHICLE BATTERIES

PROJECTS:	10	FUNDING YEAR:	2010
TOTAL INVESTMENT:	\$36.3 million	PROGRAM DIRECTOR:	Multiple
PROJECT DETAILS:	www.arpa-e.energy.gov/ProgramsProjects/BEEST.aspx		

PROGRAM

The U.S. spends nearly a \$1 billion per day to import petroleum, but we need dramatically better batteries for electric and plug-in hybrid vehicles (EV/PHEV) to truly compete with gasoline-powered cars. The 10 projects in ARPA-E's BEEST program, short for "Batteries for Electrical Energy Storage in Transportation," could make that happen by developing a variety of rechargeable battery technologies that would enable EV/PHEVs to meet or beat the price and performance of gasoline-powered cars, and enable mass production of electric vehicles that people will be excited to drive.

INNOVATION NEED

Most of today's EV/PHEVs store electrical energy in lithium-ion batteries—the same general battery type used in cell phones and laptop computers. To offer performance comparable to gasoline-powered cars, EV/PHEVs must be able to deliver the kind of power that will make electric cars fast, responsive, and exciting to drive. They also must be able to travel at least 300 miles on a single charge—the approximate driving range per tank of gas—for a comparable cost. This would require batteries with double the energy density and one-third the cost of today's state-of-the-art lithium-ion battery packs.

BEEST BATTERY GOALS

- Cost-competitive with traditional cars
- 30% of today's cost at 2-5x energy storage
- 300-500% longer battery life + range

All batteries have positive and negative electrodes and an electrolyte. In a battery, metal ions move between the electrodes through the electrolyte in order to store energy. To realize ARPA-E goals, ARPA-E funding recipients will need to reevaluate each part of the battery's composition, as well as the materials these components are made of. By using this ground-up approach, we can improve storage capacity, size and weight, stability, rechargability, and cost. BEEST projects are exploring a variety of potential solutions including radical improvement of today's lithium-ion technologies, designs using other metals such as magnesium, sodium and zinc, and new ways of using lithium in lithium-sulfur and lithium-air batteries.

POTENTIAL IMPACT

If successful, BEEST battery technologies would give EV/PHEVs the driving range, performance, lifetime, and cost required for mass adoption, which would shift transportation energy from oil to the domestically powered U.S. electric grid.

- **SECURITY:** Greater use of EVs would decrease U.S. dependence on foreign oil—the transportation sector is the dominant source of this dependence. Each day, the U.S. spends nearly \$1 billion on foreign oil to power its cars, trucks and planes.
- **ENVIRONMENT:** The transportation sector accounts for roughly 28% of U.S. greenhouse gas emissions. Batteries that allow these vehicles to be powered by the electric grid instead of petroleum could create significant reductions in greenhouse gas emissions.
- **ECONOMY:** BEEST batteries could allow EVs and PHEVs to travel 300- 500 miles on a single charge, for less than \$10 on average.
- **JOB:** The BEEST program would help position the U.S. as a leader in rechargeable battery manufacturing. Currently, the U.S. manufactures only a small percentage of all rechargeable batteries, despite inventing the majority of battery technologies